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The influence and mechanism of female-headed households on household debt risk: empirical evidence from China

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With the development of society, the number of female-headed households is on the rise. Based on the data from the China Household Finance Survey (CHFS) in 2019, this paper establishes a Tobit model to study the influence of female-headed households on household debt risk. Results indicate that female-headed households can substantially reduce household debt risk, and this conclusion still holds after overcoming endogeneity issues. Further tests on the mediating effect reveal that risk aversion and housing property holding have partial mediating effects and masking effects, respectively, in the path of female-headed households affecting household debt risk. In addition, the heterogeneity analysis indicates that the influence of female-headed households on household debt risk is more significant in third-tier cities, as well as in families without children, families without elderly members, and families with more than two elderly members. The conclusions of this paper provide a reference for the relevant policy measures to reduce household debt risk and promote gender equality.

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Introduction

As society progresses, improving women's social status has become a global trend, and countries have made significant efforts to promote gender equality, resulting in a narrowing of the gender gap (Charles, 2011). Women's social status includes political status, economic status, educational status, legal status, household status, and other aspects, among which women's household status is an important manifestation of social status. When considering gender role characteristics of households, although it is still predominantly male-dominated worldwide, the status of females in the household is increasing, and it is undeniable that there are more and more households headed by females. The so-called "female-headed households" refers to households where females have the dominant right to make decisions on family affairs. Take Chinese families as an example. According to the Fourth Chinese Survey on the Social Status of Women in 2020, 89.5% and 90.0% of wives participated in major family decisions such as "investment or loan" and "purchase or construction of a house," respectively. These figures are 14.8 and 15.6 percentage points higher than in 2010.

The improvement of female household status has spurred academic research on topics related to female-headed households. For instance, studies have explored the correlation between female household heads and household poverty (Katapa, 2006; Ayodeji et al., 2013; Fuwa, 2000), the influence of female household heads on household food security (Mallick and Rafi, 2010; Sewnet and Wang, 2023; Daniel and Augustina, 2022), the influence of female household heads on household assets (Kpoor, 2019; Debela, 2017), the influence of female household heads on housing purchase (Gandelman, 2009; Kupke et al., 2014), the influence of female household heads on children's health (Wendt et al., 2021; Kennedy and Haddad, 1994), etc. However, there has been limited research on the relationship between a female-headed household and household debt. Only a few studies have investigated the influence of female household heads on household debt levels (Ozawa and Lee, 2006), debt growth (Long, 2018), and debt repayment rates (Wong et al., 2023). On the one hand, household debt is an important factor affecting financial stability, and many central banks are highly concerned about the risk of household debt. The Bank of Canada, the Bank of Korea, and the People's Bank of China have all issued warnings that financial stability will face risks with the aggravation of household debt. According to The research group of the Institute for Advanced Research of Shanghai University of Finance and Economics (2018), household debt in China is very close to the limit that households can tolerate, and its adverse effects have been transmitted to both the real economy and the financial system, aggravating the likelihood of systemic financial risks. On the other hand, women are characterized by sensitive minds and cautious personalities (Chang, 2015), and they are more risk-averse than men (Brooks et al., 2019; Fehr-Duda et al., 2006), preferring to allocate less risky household assets (Sundén and Surette, 1998). Therefore, female-headed households will inevitably have an effect on household debt risk. The objective of this paper is to answer questions such as whether female-headed households can reduce household debt risk and how females' risk attitudes and asset allocation preferences affect household debt risk. Answers to these questions can help to establish the importance of female participation in family decision-making, provide effective solutions to address household debt risk, and raise awareness about gender equality.

This paper examines the influence of female-headed households on household debt risk. The household debt risk is measured by the ratio of total household debt to total income. Due to the truncation feature observed at zero in the debt-to-income ratio, the Tobit model is selected for testing the impact of female-

headed households on household debt risk. To address possible omitted variable bias and endogeneity issues, this paper employs an instrumental variables approach. To correct for potential estimation bias due to self-selection, this paper uses the propensity score matching method and the treatment effect model. Furthermore, in order to account for potential differences in the urban development level and family population structure that may affect the financial decisions of female-headed households, this paper conducts the heterogeneity analysis on them separately. Finally, to further validate the reliability of the empirical results, this paper uses robustness analysis methods such as examining the asset-liability ratio as the indicator of debt risk and changing the regression model.

The contributions of this paper are as follows: (1) Define the connotation of female-headed households and find appropriate variables for female-headed households. In this paper, we consider households with a female household head in the CHFS2019 database as female-headed households. It is because the household head in the CHFS database is not necessarily the household head in the household registration book but rather the person who plays a decisive role in family affairs, which is consistent with this paper's definition of female-headed households as "households where the female has the dominant right to make decisions on family affairs." In previous studies, the household heads were usually referred to as the head of household on the household registration booklet (Yang et al., 2019), or considered as the oldest family member with the highest income (Posel, 2001), or regarded as the female who does not live with their spouse (Sakamoto, 2011). Obviously, the household heads defined by previous studies do not necessarily have the dominant decision-making right regarding family affairs. (2) The female-headed households were found to be able to significantly influence household debt. The results of the study found that female-headed households can significantly reduce the risk of household debt, which provides a basis for improving the status of women and the role of women in family decision-making. (3) The influence mechanism of female-headed households on household debt risk is clarified. The results of the study suggest that risk aversion and housing property holding have partial mediating and masking effects, respectively, in the path of female-headed households reducing household debt risk.

The subsequent content of this paper is arranged as follows. Next section is the "Literature review". Section next to that presents the "Theoretical analysis and research hypothesis". After this section is the "Research design". Next section provides the "Empirical results". Penultimate section is the "Discussion and limitations". Last section is the "Research conclusions and policy implications".

Literature review

Literature related to the research topic of this paper mainly includes two aspects: the influence of gender characteristics on debt and the influencing factors of household debt.

Research on the influence of gender characteristics on debt.

Existing academic research on the influence of gender characteristics on debt has primarily focused on the influence of female executives on corporate debt. One type of research suggests that female executives have the potential to lower the level of corporate debt. Compared to their female counterparts, male executives tend to exhibit overconfidence in significant corporate decisions and issue more debt (Huang and Kisgen, 2013). Conversely, female executives have rational and cautious financing preferences that may help reduce managements' overconfidence

and lead to more rational financing decisions (Zhang et al., 2019). Furthermore, female-owned firms face more severe financing constraints due to gender discrimination against women on the supply side of financing (Asiedu et al., 2013; Hu, 2015). As a result, female CEOs can have a significant negative impact on firms' debt levels (Setiawan and Navianti, 2020). However, firms run by female CEOs that generate less financial leverage may also imply less volatile returns (Faccio et al., 2016). Another type of research takes the opposite view, arguing that female executives will raise corporate debt levels. In terms of debt maturity structure, female executives are more likely to hold a greater proportion of short-term debt than male executives (Datta et al., 2021), and the presence of female executives will improve the company's short-term debt financing level (Rocca et al., 2020). Regarding differences in corporate ownership, companies with female CEOs and non-state-owned holding companies possess higher debt financing levels, more bank borrowings, and more long-term debt (Xu et al., 2018).

Some scholars have also examined the influence of gender characteristics on household debt and found that gender characteristics will have an impact on household debt willingness, debt level, and channels. Male household heads significantly increase the likelihood of household indebtedness (Chai and Zhou, 2020), while females are more hesitant to add more unnecessary debt (Almenberg et al., 2021). The influence of gender on household debt levels is, to some extent, related to different measurement standards of debt, thus leading to inconsistent conclusions. Some scholars suggest that male household heads incur lower household debt compared to females (Brown and Taylor, 2008), while others have found that male-headed households are significantly more indebted than female-headed households (Daniels, 2001). Female household heads are more conservative and risk-averse, which has a negative effect on the demand for debt. However, there is a positive effect on the demand for debt from informal financial institutions (Jin and Li, 2009). Related to gender discrimination in credit and gender inequality in financial services (Wang et al., 2008; Fletschner, 2009; Ghosh and Vinod, 2017), females have more difficulty in accessing financing through formal financial channels, whereas male household heads are more likely to obtain loans from formal financial institutions (Cai et al., 2022; Aterido et al., 2013). Gender also influences household debt through factors such as risk attitudes, subjective debt burden, and financial self-efficacy. Females are less risk-tolerant and more cautious compared to men (Huh and Park, 2013), and they experience a higher subjective burden of debt and exhibit greater prudence and responsibility when handling household finances and debt (Keese, 2012). According to Farrell et al. (2016), females with high financial self-efficacy are more inclined to hold financial products of investment and savings and avoid debt-related financial products.

Research on the influencing factors of household debt.

Household characteristics that affect household debt include household income, demographic structure, financial literacy, and expectations about financial conditions. Some studies have found a consistent negative correlation between income and the debt-to-income ratio. Low-income households face greater debt burdens (Garber et al., 2019; Muthitacharoen et al., 2015), and debt default problems are more severe in these households (Alfaro and Gallardo, 2012). However, it has been argued that higher-income households may also increase their demand for debt and debt burden. This may be related to the purpose for which debt is taken on by households with different incomes (Christelis et al., 2021, 2015), and because of credit constraints, higher-income

households are more likely to have access to credit and incur more debt than lower-income households (Heintz-Martin et al., 2022; Coletta et al., 2019; Borowski et al., 2019). Households with females as the highest earners are more likely to be over-indebted, while households with asset income are negatively correlated with over-indebtedness (Angel and Heitzmann, 2015). Regarding household demographic structure, Guo et al. (2015) found that an increasing elderly dependency ratio and a decreasing youth dependency ratio significantly increase household debt. In terms of financial literacy, financially illiterate families with lower net assets and higher credit costs are more likely to fall into excessive debt (Gathergood and Disney, 2011). Household debt is also influenced by their expectations about future financial conditions. According to Hyytinen and Putkuri (2018), households with biased, optimistic expectations experience faster growth in debt and higher debt-to-income ratios. Additionally, excessive optimism about future financial situations can significantly increase debt servicing distress in future periods (Dawson and Henley, 2012).

Household debt is also influenced by the personal characteristics of the decision maker, such as age, health status, education level, and financial literacy. In Chinese households, the person responsible for making household decisions is typically the household head. Research has shown that older and healthier household heads are less likely to incur household debt (Chen and Li, 2011), and higher education levels are associated with lower household debt (Zhu and Xia, 2018). However, socially excluded groups, such as single parents, people with long-term illnesses or disabilities, and the uneducated, often face more severe debt problems (Patel et al., 2012). Individuals with lower debt literacy tend to engage in high-cost trading (Bucks and Pence, 2008), resulting in higher fees and the use of high-cost borrowing (Lusardi and Tufano, 2015). Household financial literacy also affects the channels through which households acquire debt, with those who have higher levels of financial literacy being more likely to obtain loans from formal sources (Huang et al., 2022; Klapper et al., 2013). Furthermore, household heads who follow patterns of conformity, as well as exhibit neurotic personality traits, significantly increase the probability and scale of household debt (Zhou and Feng, 2020).

Macro factors that affect household debt primarily include the housing market and the economic environment. Studies have shown that rising house prices (Kim et al., 2014; Meng et al., 2013), as well as price increases in the economy (Lerskullawat, 2020), a booming consumer credit market, and increased investment, are contributing factors (Dumitrescu et al., 2022). The widening income gap is also a factor in the growth of household debt, with low-income households experiencing a faster growth rate of their debt (Carr and Jayadev, 2015). The development of payment instruments and digital financial inclusion can also impact household debt. The use of mobile payments has also been linked to an increase in household debt (Chai, 2020). Additionally, the development of digital inclusive finance has been found to significantly contribute to the rise in household debt (Chen et al., 2022; Zhang et al., 2023).

In summary, the literature on the influence of gender characteristics on debt and debt influencing factors is rich and provides theoretical support for this paper's research. However, there are two aspects that still requiring an in-depth study. First, previous research on female-headed households and household debt has mainly focused on the relationship between gender characteristics and debt behavior, while there is a scarcity of literature that examines the influence of female-led financial decision-making on household debt risk from the perspective of female-headed households. Second, the mechanisms through

which female-headed households influence household debt have not been thoroughly explored.

Theoretical analysis and research hypothesis

The influence of female-headed household on household debt risk. Unlike the traditional Chinese concept of “supporting the husband and teaching the children,” females are increasingly taking on senior management positions (Dreher, 2003), performing well in both corporate leadership and household maintenance (Anyanwu et al., 2023; Iyiola and Azuh, 2014; Nwosu et al., 2019). A report by the Chinese Academy of Financial Inclusion (CAFI, 2021) states that Chinese women perform better overall in financial health than men, especially in terms of balancing income and expenses and rationally planning debts, indicating that women are breaking through gender barriers and are capable of managing family finances rationally. Furthermore, there is a growing focus on promoting female financial empowerment (Ali et al., 2021). Efforts have been made to tackle gender inequality in the financial industry (Park et al., 2021; Cabeza-García et al., 2019), and women’s involvement in managing household finances has been further protected. In terms of debt-related decisions, females tend to be more cautious (Keese, 2012; Anon, 2012), and evidence suggests that they generally have a better debt repayment performance (Wong et al., 2023; Kevane and Wydick, 2001; Sharma and Zeller, 1997). Financial decisions within households can be influenced by gender and the division of roles among household members, and as the financial managers of the family, female household heads will influence household debt performance. Based on this analysis, this paper proposes the following hypothesis:

H1: Female-headed households significantly reduce household debt risk.

The influence mechanism of female-headed household on household debt risk. If female-headed households have a significant influence on household debt risk, then deeper issues will inevitably arise: how does the female-headed household influence household debt risk, and what is its transmission path? Based on Hypothesis H1 and combining research from sociology, psychology, and economics on the influence of gender characteristics regarding debt issues, this paper proposes that female-headed households affect household debt risk through the following two important mechanisms: risk aversion and housing property holding.

Female attitudes towards debt risk. Numerous studies have demonstrated gender differences in risk preferences (Yuan, 2017). Research has shown that females have a lower risk tolerance than males (Grable, 2000), and they are generally more risk-averse than males (Nelson, 2015; Croson and Gneezy, 2009). They are more cautious and conservative and more inclined to risk aversion when taking risks (Saltık et al., 2023; Jianakoplos and Bernasek, 1998). According to behavioral finance theory, individual economic decisions are often influenced by cognitive biases such as risk preference and overconfidence, leading to irrational decisions. In the financial field, men show higher overconfidence, engaging in more debt acquisition and issuance (Hu, 2021; Huang and Kisgen, 2013), trading more than rational investors. However, overconfidence may lead to underestimation of risk and overestimation of expected utility (Heaton, 2019; Zeng et al., 2023), while women’s investment style, influenced by personal characteristics, is more cautious and financially stable (Chang, 2015). When faced with uncertainty and risk, women’s risk aversion may lead them to be more cautious about debt-incurring behaviors such as borrowing and more willing to take avoidance

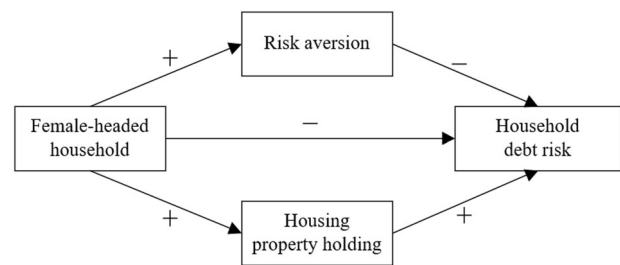


Fig. 1 A theoretical model of female-headed households and household debt risk. In the figure, “Female-headed household” represents the independent variable, “Household debt risk” represents the dependent variable, and “Risk aversion” and “Housing property” represent the two mediating variables. The symbols “+” and “-” represent the positive and negative interaction relationships between variables, respectively.

measures against increasing household debt risk. Studies have shown that females exhibit greater relative risk aversion when allocating wealth to defined contribution pension assets (Bajtelsmit, 1999), and for married households with joint investment decisions, gender differences are an important factor in explaining individual retirement asset allocation, with women’s asset allocation being more risk-averse than men’s (Arano et al., 2010). Based on this analysis, this paper argues that the debt risk attitude of the household head is a crucial factor that influences household debt. If the household head tends to take lower risks, they may be more willing to make low-risk debt decisions, thus affecting household debt. Therefore, the following hypothesis is proposed:

H2: Females are more risk-averse, and risk aversion mediates the effect between female-headed households and household debt risk; that is, the more obvious risk aversion presented by female-headed households, the lower the household debt risk.

Female asset allocation preferences. In terms of family asset allocation, females prefer low-risk assets and are more willing to hold low-risk assets such as real estate and bank deposits than higher-risk assets such as stocks, bonds, and other types of financial funds for the purpose of risk aversion and financial stability. In terms of the actual situation of Chinese households, housing assets account for more than 64.9% of the total assets in Chinese households, while housing liabilities account for more than 40% of the total liabilities in Chinese households¹. Therefore, on the one hand, due to their own robust characteristics, females may hold more housing property (Liu et al., 2021), and household liabilities are mainly housing liabilities (Li, 2022). On the other hand, owning more properties also means that housing liabilities may be higher, which increases the risk of household debt. It has been found that the higher the house ownership rate of households in the Nordic countries and the UK, the greater the size of debt (Debelle, 2004). A study by He et al. (2012) based on data from Chinese households also concluded that the higher the proportion of property holding, the higher the probability of household indebtedness. Based on the analysis presented above, the paper proposes the following hypotheses:

H3: Females tend to hold more housing property, and housing property holding preference acts as a masking effect between female-headed households and household debt risk; that is, the higher the proportion of housing property holding presented by female-headed households, the higher the household debt risk.

Based on the analysis presented above, this paper proposes a theoretical model consisting of female-headed households as the

Table 1 Descriptive statistics of variables.

| Variable name | Mean value | Standard error | Minimum value | Maximum value |
|---|------------|----------------|---------------|---------------|
| Debt-to-income ratio | 0.853 | 3.265 | 0 | 98.847 |
| Asset-liability ratio | 0.115 | 0.743 | 0 | 51.216 |
| Female household heads | 0.140 | 0.347 | 0 | 1 |
| Risk aversion of household heads | 0.644 | 0.479 | 0 | 1 |
| Housing property holding | 0.649 | 0.271 | 0 | 1 |
| Age of household heads | 56.727 | 12.235 | 17 | 102 |
| Health level of household heads | 3.247 | 1.003 | 1 | 5 |
| Years of education of household heads | 8.786 | 3.782 | 0 | 22 |
| Family size | 3.341 | 1.574 | 1 | 15 |
| Number of participants in social security | 2.049 | 1.171 | 0 | 8 |
| Number of participants in medical insurance | 3.064 | 1.605 | 0 | 15 |
| Whether to have an owner-occupied housing | 0.996 | 0.065 | 0 | 1 |
| Logarithmic household consumption expenditure | 10.785 | 0.826 | 7.614 | 18.949 |
| Logarithmic household deposit assets | 5.786 | 4.835 | 0 | 14.914 |
| Whether to use the Internet | 0.697 | 0.460 | 0 | 1 |
| Urban and rural background | 0.449 | 0.497 | 0 | 1 |

independent variable, household debt risk as the dependent variable, and risk aversion and housing property holding as the mediating variables. The model’s mechanism is illustrated in Fig. 1.

Research design

Data source and sample selection. The data comes from the CHFS2019 database, and the survey sample covers 29 provinces (autonomous regions, municipalities directly under the Central Government), 343 districts and counties, and 1360 village (neighborhood) committees, including 34,643 families and 107,008 family members. The samples in this paper are processed as follows to ensure reliable research results: (1) excluding the samples with missing key variables; (2) excluding the samples with negative income or zero consumption expenditure; (3) Considering the interference of extreme values on model results, this paper applies winsorization to the data of income and liabilities. Furthermore, households with total assets exceeding 100 million yuan have been excluded. After data processing, a total of 20,919 valid sample data was finally obtained.

Variables declaration and descriptive statistics

Variables declaration

Explanatory variables: The core explanatory variable is female-headed households, measured by the female household head variable, and this variable is assigned a value of 1 if the household head is female and 0 otherwise. It should be noted that the household head in the CHFS2019 database refers to those who play a decisive role in family affairs, not necessarily the household head on the registration booklet. This aligns with the paper’s definition of female-headed households as “households where females have the dominant right to make decisions on family affairs.

Explained variables: The paper’s explained variable is household debt risk, which is measured by the debt-to-income ratio, that is, the ratio of total household debt to total income. In the CHFS2019 database, the total household debt encompasses 11 items, namely agricultural liabilities, industrial and commercial liabilities, housing liabilities, store liabilities, vehicle liabilities, other non-financial assets liabilities, financial assets liabilities, education liabilities, credit card liabilities, medical liabilities, and other liabilities. Furthermore, there are five types of income comprising total household income. These include wage income,

agricultural income, industrial and commercial income, property income, and transfer income. The higher the debt-to-income ratio, the greater the pressure on the household to use its income to repay its debts and the higher the potential household debt risk, which could lead to a default on the household debt.

Mediating variables: The mediating variables in this paper are risk aversion and housing property holding, which are measured by risk aversion and the proportion of housing assets in total assets, respectively. Among them, risk aversion is a 0–1 variable. For the question in the CHFS questionnaire about “If you have a fund for investment, which investment project would you be most willing to choose?” The answers to “slightly lower risk, slightly lower return” and “unwilling to take any risk” are defined as risk aversion and assigned a value of 1, otherwise 0.

Control variables: This paper examines control variables through three levels: individual characteristics of the household head, family characteristics, and regional characteristics. Individual characteristic variables include the age, education level, and health level of household heads. Family characteristics include family size, the number of participants in social security, the number of participants in medical insurance, whether they have their housing owner-occupied, household consumption expenditure, household savings assets, and whether they use the Internet (the value is assigned to 1 if using smartphones, otherwise it is 0); the variables at the regional level consist of urban and rural background (with a score of 1 for rural households and 0 for urban households), as well as the geographical region (encompassing four regions in eastern, central, western, and northeastern China).

Descriptive statistics. The descriptive statistics of the main variables are presented in Table 1, where the mean value of the household debt-to-income ratio is 0.853, the mean value of the asset–liability ratio is 0.115, and the percentage of female-headed households is 14%. The mean value of risk aversion of household heads is 0.644, which means that the majority of household heads in the country are risk-averse. The mean value of housing property holdings is 0.649, which means that the average household assets have 64.9% of its total assets in the form of house equity. The mean health level of household heads is 3.247, indicating that the majority of household heads are in between “fairly healthy” and “very healthy.” The mean value of years of

Table 2 Univariate analysis.

| | Female-headed households | Other household MEAN (2) | Difference DIFFERENCE = (2)–(1) |
|--------------------------|--------------------------|--------------------------|---------------------------------|
| Debt-to-income ratio | 0.752 | 0.869 | 0.116*(1.79) |
| Asset-liability ratio | 0.088 | 0.120 | 0.031**(2.12) |
| Risk aversion | 0.662 | 0.641 | –0.021**(-2.22) |
| Housing property holding | 0.706 | 0.639 | –0.066***(-12.33) |

t values in parentheses.
*p < 0.05, **p < 0.01, ***p < 0.001.

Table 3 Summary of the discrimination of mediating effects.

| Criteria for discrimination | Conclusions |
|--|--|
| ① c_1, γ_2 significant, γ_1 not significant | Complete mediating effect (significant indirect effect, non-significant direct effect) |
| ② c_1, γ_2, γ_1 are all significant | Other mediating effects may exist (both indirect and direct effects are significant) |
| ③ On the basis of the establishment of ②, $c_1 \times \gamma_2$ has the same sign as γ_1 | There is a partial mediating effect (in this case $ \beta_1 > \gamma_1 $) |
| ④ On the basis of the establishment of ②, $c_1 \times \gamma_2$ has the different sign as γ_1 | There is a masking effect (in this case $ \beta_1 < \gamma_1 $) |

education of household heads is 8.786, which means that household heads have an average education level of middle school, reflecting that the education level of household heads is generally not high. The average family size is 3–4 people, and the vast majority of families have owner-occupied housing. The mean value of Internet use is 0.697, which means that more than 2/3 of the households use the Internet, indicating a high Internet penetration rate.

Univariate analysis. Table 2 presents a univariate analysis that compares the mean differences in debt-to-income ratio, asset-liability ratio, risk aversion, and housing property holding between female-headed households and other households. According to Table 2, it can be seen that: (1) For female-headed households, the mean value of debt-to-income ratio and asset-liability ratio is 0.1165 and 0.1154 smaller than other households, with significance levels of 10% and 5%, respectively; (2) The risk aversion level of female-headed households is higher than that of other households, and the mean difference is significant at the 5% level; (3) The mean proportion of housing assets to total assets in female-headed households is 0.0664 higher than other households, significantly at the 1% level.

Model setting. Since the explanatory variable (debt-to-income ratio) has a clear truncation at 0, the Tobit model is adopted:

$$\text{Tobit}(\text{DIR}_i) = \beta_0 + \beta_1 \text{Fhead}_i + \beta_2 \text{Convar}_i + \text{Region}_i + \varepsilon_i \quad (1)$$

In model (1), i represents the household, DIR_i is the debt-to-income ratio variable, Fhead_i is the female-headed households variable, Convar_i represents the control variable, includes individual, family, and urban-rural background and other characteristic variables, Region_i represents the regional fixed effect, ε_i is a random disturbance term. To further investigate the mediating effect of female-headed households on household debt, the following model is constructed:

$$M_i = c_0 + c_1 \text{Fhead}_i + c_2 \text{Convar}_i + \text{Region}_i + \varepsilon_i \quad (2)$$

$$\text{Tobit}(\text{DIR}_i) = \gamma_0 + \gamma_1 \text{Fhead}_i + \gamma_2 M_i + \gamma_3 \text{Convar}_i + \text{Region}_i + \varepsilon_i \quad (3)$$

In model (1), β_1 represents the total effect of female-headed households on household debt risk; In models (2) and (3), M_i is

the two mediating variables (risk aversion and housing property holding) in this paper; c_1 is the effect of female-headed households on the mediating variables; γ_1 is the direct effect of female-headed households on household debt risk after adding the mediating variables and $c_1 \times \gamma_2$ is the indirect effect of female-headed households on household debt risk.

According to the mediating effect test process provided by Wen and Ye (2014), the first step is to test whether the total effect β_1 is significant, then determine whether c_1 is indeed significant. Finally, based on the significance of the direct effect γ_1 , we can assess the presence of a mediating effect of the two mediating variables between the explanatory and explained variables. To better understand the mediating effect, this paper also refers to the distinction between the mediating effect and masking effect in the mediating analysis method of MacKinnon et al. (2000), which means that the mediating effect reduces the total effect between the explanatory variable and the explained variable, while masking effect increases the total effect between the explanatory variable and the explained variable. Based on the actual situation in this paper, several possible situations are summarized in Table 3.

Empirical results

Results of the benchmark regression model. Table 4 reports the corresponding results of the Tobit model by sequentially adding individual, family, and region characteristic variables, corresponding to columns (1)–(3), and column (4) is the marginal effect of column (3). From columns (1)–(3), female-headed households suppress household debt risk and are significant at 1%; from column (4), household debt risk will decrease by 14.29 percentage points when the household is headed by a female. Therefore, it can be concluded that without considering the influence of risk aversion and housing property holding, female-headed households will significantly reduce the risk of household debt, and H1 is confirmed.

From the parameter estimates of the main control variables: having their owner-occupied housing, larger family size, using the internet, higher household consumption expenditure and rural households are positively associated with household debt risk, while the household head who is older and healthier, the more members participating in social security and larger household deposit assets significantly reduce household debt risk, and the

Table 4 The influence of female-headed households on household debt risk.

| | Risk of household debt | | | |
|---|------------------------|--------------------|--------------------|--------------------|
| | Tobit | | Edge effect | |
| | (1) | (2) | (3) | (4) |
| Female-headed households | -0.538*** (-3.61) | -0.495*** (-3.32) | -0.480*** (-3.20) | -0.143*** (-3.20) |
| Age of household heads | -0.158*** (-33.26) | -0.130*** (-25.16) | -0.122*** (-23.52) | -0.036*** (-23.20) |
| Health level of household heads | -0.874*** (-16.20) | -0.743*** (-13.72) | -0.695*** (-12.83) | -0.207*** (-12.77) |
| Years of education of household heads | -0.081*** (-5.59) | -0.034** (-2.15) | -0.015 (-0.92) | -0.004 (-0.92) |
| Family size | | 0.350*** (5.24) | 0.330*** (4.94) | 0.098*** (4.94) |
| Number of participants in social security | | -0.217*** (-4.40) | -0.208*** (-4.19) | -0.062*** (-4.19) |
| Number of participants in medical insurance | | -0.046 (-0.72) | -0.067 (-1.04) | -0.020 (-1.04) |
| Whether to have an owner-occupied housing | | 1.848** (2.12) | 1.928** (2.21) | 0.574** (2.21) |
| Logarithmic household consumption expenditure | | 0.807*** (10.87) | 0.925*** (12.14) | 0.276*** (12.11) |
| Logarithmic household deposit assets | | -0.269*** (-22.89) | -0.260*** (-22.06) | -0.077*** (-21.79) |
| Whether to use the Internet | | 0.473*** (3.49) | 0.488*** (3.59) | 0.145*** (3.59) |
| Urban and rural background | | | 0.228** (1.99) | 0.068** (1.99) |
| i.Region | N | N | Y | Y |
| Constant term | 9.276*** (24.43) | -3.163*** (-2.61) | -6.233*** (-4.98) | |
| Observations | 20,919 | 20,919 | 20,919 | 20,919 |
| Pseudo-R ² | 0.021 | 0.033 | 0.036 | |

t values in parentheses in columns (1)-(3), z-statistic values in parentheses in column (4).
 p < 0.01, *p < 0.001.

Table 5 Effect of female-headed households on household debt risk (regression of instrumental variables).

| | Household debt risk IV Tobit |
|---|---------------------------------|
| Female-headed households (t price) | -1.766*** (-3.20) |
| Control variable | Y |
| Observations | 20,919 |
| First-stage F-value | 143.02 |
| First-stage instrumental variable t-value | 41.15 |
| Second-stage Wald test (p-value) | 5.27** (0.022) |

Limited to space, not all control variables are listed; the same applies to the following.
 p < 0.01, *p < 0.001.

number of participants in medical insurance has no significant effect on household debt risk.

Endogeneity issues

Instrumental variables approach. Regression models may suffer from endogeneity issues due to omitted variables and reverse causality. When the household debt risk is low, the household may also choose a female as the household head; that is, there may be a mutually causal relationship between the household debt risk and female-headed households. In addition, whether a female is the household head may also be influenced by unobservable factors such as personal personality and social relations. Given the possible estimation bias due to endogeneity issues, this paper adopts the instrumental variable method to estimate the model (1) in two stages. After multiple attempts, the instrumental variable chosen in this paper is the rate of female household heads in the same community, that is, the proportion of the number of households headed by females to the total number of households in the community. On the one hand, the greater the number of households headed by females in the same community, the greater the likelihood that a female is the household head due to the potential influence of the community environment. This satisfies the correlation condition of the instrumental variable. On the other hand, the rate of

female-headed households in the same community is not directly related to the household debt risk of other households, so it satisfies the exogeneity condition of the instrumental variable. Therefore, it is theoretically feasible to choose the rate of female household heads in the same community as the tool variable of female-headed households.

Table 5 reports the results of the instrumental variable regression. The t value of the first stage regression of the instrumental variable test is 41.15, which means the rate of female household heads in the same community had a positive effect on female household heads and was significant at 1%, and the F value was 143.02, greater than the critical value of 10, so the problem of weak instrumental variables does not exist. The second stage estimation of the instrumental variable test shows that the Wald test value of the Tobit model passed the 5% significance test, which indicates that the instrumental variables selected in this paper could better overcome the endogeneity issues of the regression model, and after overcoming the endogeneity issues, the female-headed households will still significantly reduce the household debt risk.

Propensity score matching method. The propensity score matching method (PSM) can alleviate the estimation bias caused by the self-selection problem to some extent. The steps of calculating the average treatment effect on the treated (ATT) of female-headed households are as follows: Firstly, variables such as age, years of education, health level, family size, and whether the family has an owner-occupied housing are selected for Logit regression to estimate the propensity score; then, one-to-four propensity score proximity matching, radius matching, and kernel matching are performed; to further validate the robustness of the treatment effects obtained using the propensity score matching method, the bootstrap method was conducted using 500 bootstrap samples, and the bootstrap standard errors and p-values were obtained. Table 6 reports the PSM test results, in which the results of the one-to-four matching reveal that the average treatment effect on treated female-headed households was -24.5%, significant at the 1% level, and the estimates of radius matching and kernel matching are generally consistent with those of the one-to-four nearest neighbor matching. Moreover, all variables demonstrate a

Table 6 Influence of female-headed households on household debt risk (propensity score matching).

| Matching method | Outcome variables | Treated group | Control group | ATT | Std. err. | t-value | Bootstrap std. err. | p-value |
|----------------------|---------------------|---------------|---------------|--------|-----------|---------|---------------------|---------|
| One-to-four matching | Household debt risk | 0.752 | 0.998 | -0.245 | 0.071 | -3.46 | 0.083 | 0.003 |
| Radius matching | Household debt risk | 0.752 | 0.909 | -0.157 | 0.057 | -2.73 | 0.056 | 0.005 |
| Kernel matching | Household debt risk | 0.752 | 0.907 | -0.155 | 0.057 | -2.70 | 0.056 | 0.005 |

Table 7 Boundary sensitivity analysis.

| Gamma | One-to-four matching | | Radius matching | | Kernel matching | |
|-------|----------------------|--------|-----------------|------|-----------------|------|
| | sig+ | sig- | sig+ | sig- | sig+ | sig- |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.6 | 0 | <0.001 | 0 | 0 | 0 | 0 |
| 1.7 | 0 | <0.001 | 0 | 0 | 0 | 0 |
| 1.8 | 0 | <0.001 | 0 | 0 | 0 | 0 |
| 1.9 | 0 | <0.001 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0.002 | 0 | 0 | 0 | 0 |

standardized deviation of <10% after matching, satisfying the balance requirement.

Boundary sensitivity analysis. The PSM method is prone to hidden bias problems attributed to unobservable variables. To further test the robustness of the results, this paper uses the boundary method to assess the sensitivity of PSM estimation results to hidden biases. The parameter Gamma represents the impact of unobserved confounding factors on household debt risk. If the conclusion is not significant when Gamma is close to 1, it can be inferred that the PSM results are not robust. This paper estimates hidden biases for three matching methods, and Table 7 reports the results of the sensitivity analysis, showing that there is no sensitivity when the Gamma coefficient is between 1 and 2, indicating that the hidden bias problem in PSM estimation can be ignored and that the estimation results based on the PSM model are robust.

Treatment effect model. The treatment effect model is also able to alleviate the estimation bias resulting from the self-selection problem to some extent. The endogenous variable “female-headed households” is a binary dummy variable, allowing for the adoption of a treatment effects model. Table 8 reports the estimation results of the two-step approach of the treatment effect model. The results of the first-stage Probit regression show that the rate of female household heads in the same community has a positive impact on female household heads, and it is significant at 1%. Furthermore, endogeneity tests using likelihood estimation indicate that it passes the significance level test of 5%. The final results of the treatment effect model show that female-headed households still have a significant inhibitory effect on household debt risk, and it is significant at the 1% level.

Analysis of mediating effects. Table 9 shows the results of the mediating effect test: (1) Risk aversion channel. Firstly, this paper tests whether female-headed households have a significant impact on the risk aversion variable, that is, the significance of c_1 . The results show a positive correlation between female-headed households and risk aversion, with a regression coefficient of

0.0234 and a significance level of 5%, indicating that female-headed households will significantly increase the probability of risk aversion. Secondly, this paper determines the significance of γ_2 and γ_1 . The regression results indicate that risk aversion significantly reduces household debt risk, and even after controlling for the risk aversion variable, female-headed households still significantly reduce household debt risk, i.e., both γ_2 and γ_1 are significant. Up to now, both direct effect γ_1 and indirect effects $c_1 \times \gamma_2$ are significant. Finally, based on the regression results, it is known that $c_1 \times \gamma_2$ and γ_1 are of the same sign, and the absolute value of the total effect $\beta_1(-0.143)$ is greater than that of the direct effect $\gamma_1(-0.138)$, indicating that there is a partial mediating effect of risk aversion in the path of female-headed households on household debt risk.

(2) Housing property holding channel. Firstly, this paper tests whether female-headed households have a significant impact on the housing property holding variable, that is, the significance of c_1 . The results show that the regression coefficient of housing property holding on female-headed households is 0.049, which is significantly positive at the 1% level, indicating that female-headed households will significantly increase the housing property holding. Secondly, the regression results show that housing property holding significantly increases the household debt risk. After controlling the housing property holding variable, female-headed households still significantly reduce the household debt risk as both γ_2 and γ_1 are significant. Up to this point, both direct effect γ_1 and indirect effect $c_1 \times \gamma_2$ are significant. Finally, based on the regression results, it is known that $c_1 \times \gamma_2$ and γ_1 have different signs, and the absolute value of the total effect $\beta_1(-0.143)$ is smaller than that of the direct effect $\gamma_1(-0.169)$. According to MacKinnon et al. (2000), it can be seen that housing property holding has a masking effect in the path of female-headed household’s influence on household debt risk. Based on the above analysis, H2 and H3 are validated.

Heterogeneity analysis. The influence of female-headed households on household debt risk may vary according to the availability of financial services, the source of household labor and income, and the characteristics of household consumption and expenditure, which tend to be related to the level of urban development and family population structure (Bai, 2021; Afjal, 2023; Zheng et al., 2023), which this paper analyses for heterogeneity. In terms of the differences in the impact of urban development levels, this paper follows the division of urban development levels as noted in the questionnaire to analyze the differences in their impact. The study divides the sample into households in the first-tier, new first-tier, second-tier, and third-tier cities, as well as cities below the third-tier. In terms of differences in the impact of family population structure, the population aged 14 and below is defined as the child population, and the population aged 65 and above is defined as the elderly population. Based on this, the sample is further divided into households with 0, 1, 2, and more children according to the number of children in the family, and households with 0, 1, 2, and more elderly population according to the number of elderly people in the family.

Table 8 Influence of female-headed households on household debt risk (treatment effect model).

| Second-stage regression results | |
|--|--------------------------|
| Variable | Household debt risk |
| Female-headed households (z value) | -0.746*** (-3.48) |
| Control variable | Y |
| Observed value | 20919 |
| Chi ² for the LR test | 4.59** |
| (p-value) | (0.032) |
| First-stage regression results | |
| Variable | Female-headed households |
| Female household head rate in the same community (z value) | 4.283*** (41.10) |
| Pseudo-R ² | 0.106 |

p < 0.01; *p < 0.001.

Table 9 Results of the mediating effect tests.

| variable | Total effect | Risk aversion channels | | Housing property holding channels | |
|--------------------------|---------------------|------------------------|---------------------|-----------------------------------|---------------------|
| | Household debt risk | Risk aversion | Household debt risk | Housing property holding | Household debt risk |
| Female-headed households | -0.143*** (-3.20) | 0.023** (2.43) | -0.138*** (-3.10) | 0.049*** (9.68) | -0.169*** (-3.77) |
| Risk aversion | | | -0.180*** (-5.68) | | |
| Housing property holding | | | | | 0.554*** (9.05) |
| Control variable | Y | Y | Y | Y | Y |

z-statistic values in parentheses and the coefficients represent marginal effects.
p < 0.01, *p < 0.001.

Table 10 Impact at different urban development levels.

| | Urban development level | | |
|--------------------------|---------------------------------|--------------------|-----------------------------|
| | First and new first-tier cities | Second-tier cities | Third-tier cities and below |
| Female-headed households | 0.097 (0.46) | 0.445 (0.95) | -0.645*** (-3.23) |
| Control variable | Y | Y | Y |
| i.Region | Y | Y | Y |
| Observations | 4589 | 2735 | 13,595 |
| Pseudo-R ² | 0.054 | 0.033 | 0.032 |

***p < 0.001, t values in parentheses.

Table 11 Differences in family population structure.

| | Number of children in the household | | | Number of elderly members in the household | | |
|--------------------------|-------------------------------------|----------------|--------------|--|----------------|-----------------|
| | 0 | 1 | 2 or more | 0 | 1 | 2 or more |
| Female-headed households | -0.654*** (-3.43) | -0.241 (-0.86) | 0.096 (0.20) | -0.482** (-2.58) | -0.095 (-0.25) | -0.596* (-1.90) |
| Control variable | Y | Y | Y | Y | Y | Y |
| i.Region | Y | Y | Y | Y | Y | Y |
| Observations | 14,416 | 4055 | 2447 | 11,811 | 4358 | 4750 |
| Pseudo-R ² | 0.041 | 0.0234 | 0.015 | 0.024 | 0.034 | 0.061 |

t values in parentheses.
*p < 0.05, **p < 0.01, ***p < 0.001.

Differences in urban development level. Table 10 presents the impact of female-headed households on household debt risk under different urban development levels. The results show that the inhibitory effect of female-headed households on household debt risk was only significant in households in third-tier cities and

below, while no significant effect was observed in households in first-tier and new first-tier cities and second-tier cities.

Differences in family population structure. Table 11 reports the impact of female-headed households on household debt risk

Table 12 The effect of female-headed households on the household asset-liability ratio.

| | Asset-liability ratio | | | |
|--------------------------|-----------------------|----------------------|----------------------|----------------------|
| | Tobit | | | Edge effect |
| | (1) | (2) | (3) | (4) |
| Female-headed households | -0.116*** (-3.55) | -0.101*** (-3.08) | -0.093*** (-2.82) | -0.025*** (-2.82) |
| Individual level | Y | Y | Y | Y |
| Family level | N | Y | Y | Y |
| i.Region | N | N | Y | Y |
| Observations | 20,919 | 20,919 | 20,919 | 20,919 |
| Pseudo-R ² | 0.027 | 0.045 | 0.051 | |

t values in parentheses in columns (1)-(3), z-statistic values in parentheses in column (4). ***p < 0.001.

when there are differences in family population structure. The findings demonstrate that the inhibitory effect of female-headed households on household debt risk is significant in households without children, without an elderly population, and with two or more elderly persons. However, it is not significant in households with one child, two or more children, or one elderly person.

Robustness test

Replace the measurement indicators of debt risk. To further demonstrate the robustness of the research results, this paper uses asset-liability ratio instead of debt-to-income ratio to measure household debt risk. Table 12 reports the estimation results of the model with the sequential inclusion of individual, family, and regional characteristic variables and the results show that similar to the debt-to-income ratio, female-headed households also have a negative effect on household debt risk and are significant at the 1% level.

Replace the model. The Tobit model is used to predict the probability of target occurrence. Female-headed households are found to significantly reduce the household debt risk, whereas other household heads also reduce the debt-to-income ratio, while female-headed households may also increase the debt-to-income ratio. Therefore, to eliminate the doubts of the probability model, this paper also employs an OLS regression model to examine the effect of female-headed households on household debt risk. The results show that the regression coefficient of female-headed households on household debt risk is -0.1656, significant at the 1% level.

Provincial fixed effects. The basic model sets regional dummy variables to control for regional fixed effects. To further avoid the estimation error, the paper also controls the provincial fixed effect by setting the provincial dummy variables. The results show that the regression coefficient of female-headed households on household debt risk is -0.373, which is significant at the 5% level, proving that the basic conclusion is robust.

Discussion and limitations

Discussion. This paper examines the influence of female-headed households on household debt risk using a Tobit model and finds that female-headed household significantly reduces household debt risk, adding to the arguments in favor of female participation in the family economies. This conclusion also supports, to some extent, previous studies that suggest females are less likely to

incur debt (Flores and Vieira, 2014; Davies and Lea, 1995). The discussion of control variables can also be reasonably explained and supported by evidence. As the household head gets older, they may have more assets and financial experience, thereby reducing household debt holdings and household debt risk (Tseng and Hsiao, 2022; Abd Samad et al., 2023), which is consistent with the life-cycle hypothesis (Modigliani, 1986), according to which rational individuals accumulate assets during their working life to cover expenses in old age. The healthier household head borrows less due to illness, thus reducing household debt risk; for example, there are research studies showing that health problems are often the main reason for falling into financial collapse (McCloud and Dwyer, 2011). Larger family size implies a greater need for expenditure and, therefore, a greater need for debt, while household financial assets buffer against negative shocks to debt burdens (Stavins, 2021), and larger household deposit assets can better cover household expenditures (Bandelj and Grigoryeva, 2021), thus reducing household debt risk. The Internet enriches people’s channels for consumption, investment, and borrowing, and some studies have shown a positive correlation between Internet use and household debt leverage ratio (Zhou et al., 2021). Social security provides broad and long-term stable risk protection, such as pension, medical care, unemployment, work injury, and maternity insurance. The more members participating in social security, the better the household’s ability to protect itself against uncertain risks such as income shocks, and therefore the lower the demand for debt and the household debt risk. While the number of participants in medical insurance has no significant effect on household debt risk, which may be because the reimbursement ratio of basic medical insurance is generally low and its scope of coverage is limited (Hua, 2023), and households still have to bear large medical costs when facing serious illnesses. Additionally, the cumbersome reimbursement process may also cause families to face significant financial pressure in the short term. Rural households significantly increase household debt risk, possibly because they have lower incomes and need to take on more debt compared to their income to meet household expenses (He and Li, 2022; Meniago et al., 2013). Increasing household consumption expenditure will significantly increase the household debt risk (Kasoga and Tegambwage, 2021; Abd Samad et al., 2023). This may be due to the presence of a “ratchet effect” (Duesenberry, 1949), which means that consumption habits are easy to adjust upward but difficult to adjust downward, thus increasing the risk of household debt. Additionally, having their owner-occupied housing significantly increases the household debt risk, possibly because higher debt is required to purchase a house (Pastrapa and Apostolopoulos, 2015).

Regarding the mechanism of influence, risk aversion, and housing property holding have partial mediating and masking effects, respectively, in the path through which female-headed households influence household debt risk. The results are in line with expectations and consistent with some existing research conclusions. Almenberg et al. (2021) found that risk aversion is inversely related to household debt levels. Attitude towards risk is a key factor in debt or other financial decisions in the presence of risk and uncertainty in the future income distribution (Vargas-Sierra and Orts, 2023; Brown et al., 2013), and risk aversion tends to lead households to manage their debt more prudently and rationally, reducing the household debt risk by increasing savings, moderating borrowing and choosing low-risk debt (Zhou and Chen, 2020; Wang and Tian, 2012). While home ownership and higher house values tend to be associated with higher debt levels (Jarmuzek and Rozenov, 2019; Abd Samad et al., 2020), this may result firstly because borrowing to buy a house increases household debt and then increases the household debt to asset

ratio when house prices fall (Gerlach-Kristen and Merola, 2019; Meng et al., 2013). Secondly, housing for investment may put households under greater financial pressure due to falling markets or longer-than-expected repayment periods (Worthington, 2006). Additionally, owning housing property allows households to use increased house values and home equity lines of credit for further loans and financing and further increasing household debt (Coletta et al., 2019). The discussion on the influence mechanisms provides insights into women's influence on household debt risk. While recognizing that risk aversion can increase the prudence of women's financial decision-making, and females tend to increase housing property holdings in pursuit of conservatism, it should also be recognized that a lack of investment confidence and excessive risk aversion may lead to excessive investment in low-risk assets such as housing, lacking investment in assets that can yield higher returns (Black et al., 2018; Ozawa and Lee, 2006), which could cause distortion in resource allocation (Keese, 2012). Therefore, correctly assessing personal risk attitudes, receiving more financial education and improving financial literacy and fund management skills (Tseng and Hsiao, 2022; Philippas and Avdoulas, 2020; French and McKillop, 2016; Sundén and Surette, 1998), and diversifying investments within an acceptable range of risk are also important for the economic health of the household.

Heterogeneity analyses show that, in terms of urban development level, the influence of female-headed households on reducing household debt risk is significant only for households in third-tier and below, which may be related to the financial development of different cities. The lower the level of urban development, the more scarce financial resources tend to be (Liu et al., 2021; Pateman, 2011), especially in rural areas where economic development is relatively lagging behind, household economic situations are relatively fragile and rural financial infrastructure is underdeveloped with limited loan channels and low credit convenience. These factors make rural households more inclined to borrow from informal sources (Kumar et al., 2017; Wong et al., 2023) and depend more on their own financial management and risk control, and in this case, the influence of female-headed households on household financial management is more significant. They borrow more cautiously and pay more attention to reducing the household debt risk and maintaining household financial stability. Conversely, the higher the level of urban development, the better the financial infrastructure. Coupled with higher income levels and stronger debt repayment capabilities, it ultimately results in the influence of female-headed households on household debt risk not being significant.

The influence of female-headed households on household debt risk is also varied based on differences in family population structure. This may be linked to expenditure patterns and borrowing purposes. The expenditure responsibilities of male and female household heads are not consistent (Reboul et al., 2021). When considering household financial decisions, females tend to prioritize collective spending and exhibit altruistic tendencies. They often take on a significant amount of household responsibilities and are more likely to spend on children and collective goods (Kasoga and Tegambwage, 2021; Pahl, 2008). Additionally, there is a positive correlation between female-controlled household assets and household spending on children's clothing and education (Quisumbing and Maluccio, 2000). Thus, different family population structures lead to different consumption needs, affecting debt demands and borrowing decisions (Van Winkle and Monden, 2022; Kowalski et al., 2023). For example, Maroto (2018) found that children are associated with a decline in wealth for low-and middle-income families. Married couples with children are more likely to incur debts than other types of families (Xiao and Yao, 2020), and the number of children and other dependents in the family is

positively correlated with household debt (Deng and Yu, 2021; Kasoga and Tegambwage, 2021). In this study, households without young children or elderly dependents have less financial pressure, allowing more income to be allocated for savings and reducing the relative need for household debt; and therefore, a female household head significantly reduces household debt risk. For households with two or more elderly members, although the financial pressure of supporting multiple elderly members is greater, the continuous improvement in the pension service policy system and the quality of pension services will help effectively reduce the family's financial burden (Du and Wu, 2023; Han et al., 2023; Ke and Shi, 2023). Additionally, the consideration of preventing medical expenses from elderly illnesses also prompts female household heads to be more cautious in debt decisions, thus significantly reducing household debt risk. For households with one child, two or more children, and one elderly person, providing care for them can lead to economic pressure and an increase in debt demand. However, female household heads do not significantly worsen household debt after risk control due to their prudent considerations. Therefore, the influence of female-headed households on household debt risk is not significant.

Limitations. Firstly, the asset-liability ratio and debt-to-income ratio can reflect the level of household financial leverage and repayment capacity, providing a reasonable measure of household debt risk. However, these indicators do not consider the specific types and structures of household assets and liabilities, nor the source and stability of household income, while different types of assets and liabilities have varying impacts on household debt risk and the source and stability of income also affect a household's ability to service its debt in the future. Therefore, future studies could consider factors such as debt type, interest rates, employment type, income source, future income and repayment plans, and family credit records to develop a more comprehensive indicator of household debt risk. Secondly, this paper has used cross-sectional data, and in the future, the use of panel data could be considered to study the impact of female-headed households on household debt risk from a dynamic perspective, in order to gain more insights on this topic.

Research conclusions and policy implications

This paper examines the influence and mechanisms of female-headed households on household debt risk from the perspectives of gender and household status. Using CHFS2019 data, we employ the debt-to-income ratio and asset-liability ratio as indicators of household debt risk, and the study demonstrates that female-headed households can significantly decrease household debt risk. Further analysis reveals that female-headed households affect household debt risk through two important mechanisms: risk aversion and housing property holding, and there are partial mediating and masking effects in the path of female-headed households influencing household debt risk. Female-headed households reduce household debt risk through risk aversion and increase household debt risk through increased housing property holding. Differences in the impact of female-headed households on household debt risk vary across different levels of urban development and family population structure, and these differences may be related to financial infrastructure, female consumption, and expenditure characteristics.

The fact that female-headed households significantly reduce the household debt risk and their increasing ability to participate in economic decision-making is an important reference for promoting gender equality and supporting the advancement of females in both the family and society. Encouraging women's

participation in household economic decision-making and management also has a positive effect on the stable management of households and the resolution of household debt risks. The risk attitudes and asset allocation preferences of females have a significant influence on household debt management. This highlights the importance of emphasizing financial education for females and improving their financial skills, which is crucial in reducing household financial decision-making errors. Females should have a clear and correct understanding of their risk attitude and risk tolerance and avoid falling into financial difficulties due to the holding of single assets such as housing property. The different urban development levels and family population structure can affect the role of females in household debt management. This highlights the need for the government to adopt multiple approaches to increase household income and improve the level of financial infrastructure construction in underdeveloped areas while continuing to improve pension insurance policies and laws and regulations on family fertility and parenting.

Data availability

The data that support the findings of this study are available from China Household Finance Survey (CHFS) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of China Household Finance Survey (CHFS).

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Note

1 The author's calculations based on data from CHFS2019.

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BT: Conceptualization, project administration, supervision, methodology, validation, formal analysis, investigation, resources, writing—review and editing. YG (corresponding author): Methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft, writing—review and editing. YW: Methodology, software, validation, investigation, resources, data curation, writing—original draft.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors. The data used in this paper is based on secondary data, which is available in the public domain for research purposes.

Informed consent

This article does not contain any studies with human participants or animals performed by any of the authors.

Additional information

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